THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THE ELECTRIC RAILWAY.

Now that the possibility of an Electric Railway has been fairly put before the public by Dr. Siemens, we may expect to hear more about it before many years.

The commercial advantages of the system must, of course, determine whether the Electric Railway will be extensively used or not. The question is not entirely one of economy of fuel, safety and convenience are elements which greatly affect the commercial profitableness of any undertaking, and these must be taken into consideration in making an estimate.

As yet, the new means of locomotion has only been experimented upon on a comparatively small scale, but the results have been quite sufficient to justify a favourable conclusion being drawn.

The idea of an electric railway is by no means new; little model engines, which ran backwards and forwards on a pair of rails, or round and round in a circle, were often to be seen in the windows of the shops of scientific instrument makers in the early days of electrical science, and the suggestion to apply the principle on a large scale was such a natural one that it is necessary to go back to a somewhat early date in the records of the Patent Office to find the first patent for an electrical railway. So long as the motive power was dependent upon galvanic batteries but little success could be obtained, but the introduction of dynamo machines altered the question entirely and brought the idea within the range of economical possibility.

For underground railways the system is specially suitable, and those who travel on the Metropolitan Railway during the dog days must often devoutly hope that some change in this direction will be made at no distant date. Already it is contemplated to work the traffic through the new St. Gothard tunnel by electricity, and plans and designs for the purpose have been in hand.

Railways worked by electricity will, however, have to compete with a formidable rival in the shape of railways worked by compressed air locomotives. This latter means of producing locomotion appears to have woke up again and is likely to have considerable employment.

For very short distances, where the traffic is heavy and irregular, as, for instance, on the small branch lines used so frequently in mining districts, the electrical railway could be used with great advantage, especially if natural sources of power are available.

THE ELECTRICAL TOURNIQUET OF MM. FONVIELLE AND LONTIN.

THIS little instrument, presented to the Académie des Sciences during the April session, is composed of a galvanometer coil, in which is placed a small disc of soft iron, capable of rotation on a pivot which supports it. A horse-shoe magnet is set over the coil in the position shown in fig. 1, so that its polar extremities are close to the coil. If now a current of electricity is sent through the coil from a small induction coil, the disc rotates rapidly in a perfectly definite way, this being dependent upon the position of the poles of the magnet, and upon the nature of the induced currents passing through the coils. When the magnet lies *across* the coil, that is to say, at right angles to the position shown in the figure, then there is no rotation. MM. Jamin and Du Moncel have very simply explained the cause of the phenomenon. It is well known that the induced current generated on *making* the primary circuit is always more powerful than the current produced on *breaking* the same. The soft iron disc being polarised by the outside magnet becomes practically a magnetic needle in a galvanometer coil, and takes its movements under the action of a series of momentary impulses, the poles remaining fixed in space although the disc of soft iron is changed in position by the rotation. The current on breaking the primary circuit, acts in the reverse way to that produced on making, but since its strength is much less than the latter, the disc is acted upon by the difference of the two currents. Each current on *making* produces new impulses on the disc, since the poles find themselves within the field of the fixed magnet. The same movement of rotation is produced *with the direct current of a battery interrupted with great rapidity*. In this case the velocity of rotation is less, but this must be attributed to the fact that the momentary impulses are not produced sufficiently rapidly, and because, on the other hand, the resistance of the galvanometer coil is not such as would utilise the whole effect of the direct current. The movement increases itself when the current of the battery is caused to traverse an induction bobbin with a make and break, for it produces then a series of momentary impulses sufficiently close to one another to communicate to the disc a certain velocity of rotation.

By arranging two tourniquets in series, as seen by fig. 2, it is possible to produce a movement in each coil, but on withdrawing the disc from one of the tourniquets the one left in the other, turns with increased rapidity. This fact can be explained by the well known reactions which take place between magnets and currents.

The movement of rotation is produced with movable pieces of soft iron of various shapes,

needles, stars, plain discs (solid or with spokes), or with spiral bands like the balance-spring of a watch.

If the fixed magnet is removed, then the phenomenon can be produced under the action of the earth's magnetism, but to a small degree only.

The fact of the stoppage produced by placing the magnet at right angles to the position shown in the figures, proves exactly that the theory of M. Jamin is correct, for, in this case, the disc placed inside the galvanometer coil, forms, under the influence of the external magnet, a true magnetic bar placed crosswise to the movement of the current, and consequently, no action should take place under this condition.

The instrument of MM. Lontin and Fonvielle constitutes a new and original method of demonstrating the laws which govern the actions of magnets and currents, and for this reason should be placed side by side with the analogous apparatus of Ritchie, Barlow, Faraday, &c.—*La Nature.*

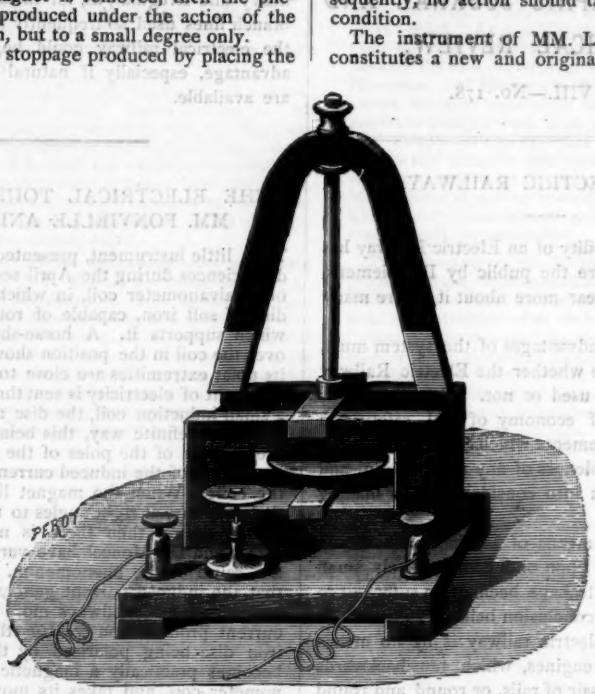


FIG. 1.

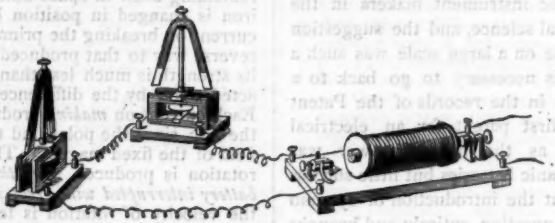


FIG. 2.

THE MARSEILLES-ALGIERS CABLES AND CHEAP TELEGRAMS.

THE number of the *Journal Officiel de la République Française* for June 17th, gives some interesting details concerning the Marseilles-Algiers Cables; it says :—

"The Budget Committee have recommended an expenditure of 1,600,000 francs for the laying of a new Marseilles-Algiers cable. They add to their recommendation the following data. Algeria is in communication with Marseilles by means of three* submarine cables. One (*sic*) of these cables is the property of an English company, who work

* There are actually *four* cables.—ED. TEL. JOUR.

it for their own profit. The two other cables belong to the French Government. The first was laid in 1871, and the second in 1879. The number of messages transmitted by the 1871 cable rose to 143,942 in 1878. The tariff at that date was 20 centimes (2d.) per word. By a decree of 25th August, 1879, this rate was reduced to 10 centimes (1d.) per word. Almost immediately, the number of messages doubled, and, in a very short time afterwards, the total receipts exceeded those of any preceding year, in spite of the fact that the rate had been reduced by 50 per cent. This product was 610,544 francs in 1878, which rose to 647,646 francs in 1879 (when, be it noted, the half rate had been in force for five months) and it now appears, from results obtained up to the 1st April, 1880, that the receipts for the present year will not be less than 718,760 francs. Up to the present time it has been found possible to meet this increasing traffic, but on several occasions a great difficulty has been found in getting rid of a press of business. This, with the fact that the 1871 cable is faulty, and is consequently not trustworthy, render imperative the laying of a new cable.

"The laying of a new cable being indispensable, your committee advises the Chamber to vote the 1,600,000 francs necessary to establish a new line. This recommendation was afterwards adopted by the Chamber and the amount voted."

It may be well to add that the two direct cables now existing are each 500 nautical miles long, and that the cost of the last one was only £57,200. Taking the two cables at £114,200 and the produce of 1d. per word rate at 710,760 francs, or £28,430, an excellent revenue results; roughly speaking, 25 per cent. per annum. The expenses should not exceed £7,000 or £8,000 at a very liberal estimate, subtracting this amount, the net revenue or interest on the capital expended amounts to 19 per cent. per annum. Here we have 1d. per word for messages passing through 500 miles of submarine telegraph cable producing a higher rate of interest than that paid by any of our submarine lines, the Submarine Telegraph Company coming second, 2 per cent. per annum under. It is a matter of congratulation to the French Government that through their enlightened policy of cheap rates they should stand first, from a money-making point of view.

ON A SIMPLE METHOD OF IDENTIFYING A SUBMERGED TELEGRAPH CABLE WITHOUT CUTTING IT.

BY W. P. JOHNSTON, Officiating Electrician, Indian Government Telegraphs.

THE following paper from the June number of the *Philosophical Magazine* being of great interest and practical value to telegraphists, we are induced to reprint it in full.

"Circumstances having arisen which rendered it desirable, and at times absolutely necessary, to be in possession of a method for identifying a submerged telegraph cable by applying certain tests to the protecting guards, the following experiments were made for the purpose."

The particular case referred to me was this:—

"How with two cables (one good and one faulty) across a river, both cables having similar guards, can one be distinguished from the other without cutting, when either one of them has been raised from the bottom on to the repairing boat? The boat being a small one, and the river running rapidly, it becomes difficult and dangerous to cut the cable in the first instance; and to make a joint simply for the purpose of identification is above all things to be avoided."

My first idea was to attach a very sensitive instrument to the guards where they were raised out of the water, to signal from the bank through the guards, and to observe the effects on this instrument, first, when the battery and instrument were joined to the guards of the same cable, and, secondly, when the battery was joined to the guards of one, and the instrument to the guards of the other cable. This, however, did not answer.

My next idea was to join an instrument to the guards, and to observe whether it was sufficiently sensitive to show any sign of the current that would be induced in the guards of the cable when a strong current was sent through the conductor; and on mentioning this to Mr. J. J. Allen, Assistant Superintendent of Indian Government Telegraphs, he suggested that in this case a telephone attached to the guards might be influenced. The value of this suggestion was clear to me; for I have reason to know how exceedingly sensitive an instrument the telephone is, having about a year ago made for Mr. Schwendler the experiment to convey messages from one bank of a river to the other without any conductor between the two banks but the water, which experiment was for a certain distance quite successful.

I may now be allowed to detail the experiments which I made with the telephone.

A B is a submerged telegraph cable about 7,300 yards long, and having an absolute translation-resistance of 580 megohms;

——— is the conductor of copper of 23 ohms resistance; the helical line represents the guards, 12 galvanised iron wires each weighing 900 lb. per mile;

C D the portion of the cable raised to the repairing boat;

E the signalling battery, joined to the conductor;

T the telephone, of 2·5 ohms resistance.

The distance C D being 12 yards, every signal that was sent through the conductor was distinctly audible on the telephone (T); reducing the distance gradually, the signals were still readable so long as that distance was not less than 6 feet. At a less distance the signals became faint; and at 3 inches only an exceedingly feeble sound could just be heard, and not sufficient for reading.

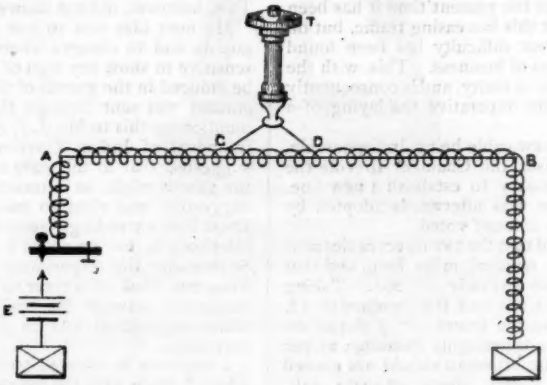
On pressing the key a sound was heard from the telephone; and on releasing the key a sound was also heard.

The explanation, of course, is simple:—"For every current made in the conductor, a current is induced in the iron guards in the opposite direction to the primary current; and for every interruption made, a current is induced in the iron guards in the same direction as the primary current. The telephone therefore receives a succession of opposite currents; and being such an exceedingly sensitive instrument, notwithstanding the very minute fraction of these induced currents which passes through the shunt

formed by the telephone, still it gives out audible sound."

As stated before, the guards were 12 galvanised iron wires each weighing 900 lb. per mile, and the resistance per mile of one 900-lb. wire = 7 ohms, the resistance per mile of twelve 900-lb. wires = $\frac{7}{12}$ ohm, and the resistance of 6 feet of twelve 900-lb. wires = 0·66 milliohm.

In this case the resistance of 0·66 milliohm offered by the 6 feet of the guards was shunted by a telephone offering with its connecting wires a resistance of 2·5 ohms. Therefore, of the currents induced in the guards by the primary current in the conductor, only $\frac{1}{3800}$ passed through the telephone.



The method which I suggest for the identification of a submerged telegraph cable is therefore as follows:—Attach a telephone of low resistance to the guards of the raised portion of the cable (which portion may be either in or out of the water), as shown in the diagram, and send signals from the bank through the conductor of one of the cables; and then, if the telephone is connected to the guards of the cable through the conductor of which the signals are being sent, those signals will be audible in the telephone.

There are doubtless many other cases in which this method may be found of practical service.

The telephone in its short history resembles very much the development of a boy whose father had brought him up to be a priest, but who, contrary to all expectations, turned out to be a general; for the application in practical telegraphy for which the telephone was invented has not turned out to be so successful as the inventor, Prof. Bell, and others anticipated. But instead of this, the instrument will undoubtedly become of the greatest assistance to physical research. In addition to signalling across rivers already referred to, Mr. Schwendler had already used the telephone for indicating the speed of the induction cylinder of a dynamo-electric machine (see *précis* of his Electric Light Report); and Professor Hughes has used it with great success in his induction-balance. It seems, in fact, the telephone is too sensitive and too quick working for practical use."

Calcutta, April 27th, 1880

THE JAMIN ELECTRIC LIGHT SYSTEM.

Memoir presented by M. Jamin to the Académie des Sciences, May 31st, 1880.

"I HAD the honour to submit to the Academy during its meeting of the 17th March, 1879, the principle of a new electric burner. I have since constructed a novel form of lamp, which I am about to describe. It rests on a slate base which can be fixed in globes or lanterns, according to the style of ornament required, and which supports near the base a grooved copper horseshoe, H, H, H, which is broad, but, at the same time, sufficiently thin to avoid shadows being cast; at the top of the horseshoe is a hollow soft iron piece, G, whose function is to magnetise and attract a movable armature, E, F. The alternate current from a Gramme machine passes first through a thin copper wire, wound three or four times round in the hollow of the horseshoe piece, H, H; this constitutes the circuit director. It is in the middle of this frame and in the same plane with it that the electric candles, or carbon couples, are placed, between which the arc is formed. There are three of these candles shown, but a greater number can be used if necessary. Each carbon is introduced in a tubular support of copper, so that they are held vertically, being clipped by a spring. The operation of fixing does not present any difficulties. There is no insulating material between the carbons. Those to the right, B, A, ... are fixed and vertical; those to the left *a*, ... hang freely on joints, B, B′, B″, ... ; the ends of their supports are held by a bar, C, C′, which presses them all to one side; the armature, E, F, is connected by a lever, E, D, to this bar, which is pressed to the left by its weight; this causes the carbons to approach and touch against their fixed neighbours. It may be remarked that the contact

is only made between one of the carbon pairs, that is to say, between the longest, or the pair whose points are closest together; it is this one which lights.

"The electric current, after having traversed the directing circuit, arrives at the same time at the three movable carbons and can return indifferently by the three fixed ones; it passes between those which touch and lights them. Immediately magnetisation takes place, the armature, E, F, is attracted, the three carbon couples separate together, two remaining cold and the arc burning between the third. It remains so as long as there is material to be consumed, being maintained at the points by the action of the directing current, and recovering necessarily if any external cause disturbs it. When the current is stopped, the armature falls back and immediately re-establishes the contact; if it passes afresh, the carbons relight and separate as at first. Thus the lighting is automatic, instantaneous, and renewable at will.

"When the first candle is consumed it must have its place taken by another. To effect this, the carbon holder to the left, which remained fixed, is hinged at its end and can move aside, not in the same plane as the horseshoe, but at right angles to this (fig. 2). It is pushed by a spring, R, which separates it, but it is maintained in the vertical position by a brass wire, B, hooked at the end, and which passes friction tight through a fillet, being pressed by a spring.

"When the combustion of the candle reaches the wire, it melts the latter and releases the carbon immediately, and the two instantly separate; the arc is broken, but it is immediately reformed on a neighbouring candle. The action is so sharp that the change to the new candle can scarcely be perceived, and the other lamps in the circuit are not affected. It must be remarked that this substitution of one candle for another only takes place every two hours, and as the brass wire is only burnt at its extremity, it is only necessary to cut the end off and pull a little more through the fillet, and then to twist it round the new carbon, so that a short piece lasts for a long time.

"One of the great inconveniences of the electric light is the possible and sudden extinction of one of the lamps, which causes all the others in the same circuit to become extinguished also, no matter in how good condition they may be. The Jamin candles are not subject to this inconvenience, as it was foreseen and remedied. To this end one of my pupils, M. Krouchkoll, has devised a parachute system, a description of which would be too lengthy; it effects, 1st, the opening, at the moment when the accident occurs, of a secondary circuit which bridges over the defective candle; 2nd, it replaces the defective candle by an equal resistance, which allows the others in the circuit to burn without change. This addition is very important, as it allows more or less candles to be lighted without a change in their light.

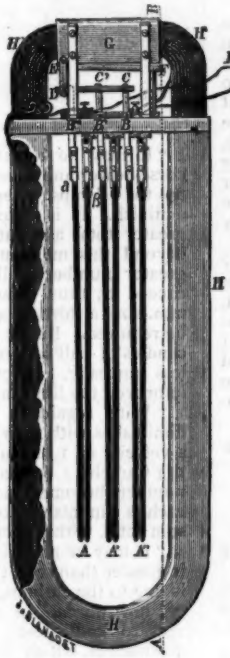


FIG. 1.

FIG. 2.

"To resume, my lamp contains several novel points; it lights and relights as often as required; it requires only one circuit for all the neighbouring candles; it replaces automatically those candles which have burnt out, with entirely new carbons; it does not employ any insulating material of a nature to change the colour of the flames, nor any preliminary preparation of the carbons, this decidedly diminishes the expense. If, at commencing, it shows, like all others, variations in the brilliancy, this will be due, not to a defect in the lamp itself but to a defect in the carbons; these variations have disappeared since, thanks to M. Carré, the necessary homogeneity has been given to the carbons. It remains, then, to say how much light can be obtained with a given amount of work, what is the quality of the light and of the heat produced, and to what distance can it be conducted.

"I have employed in these researches a Gramme machine; it was driven by an Otto gas-engine, with which it is possible at any instant to measure the work consumed, which is exactly proportional to the number of explosions; it is sufficient to count them. It is well known that the Gramme machine is composed of two distinct parts; the light machine, formed by electro-magnets turning rapidly in a ring of iron wound with inducing wires, and an excitor with continuous currents, which serves to magnetise the electro-magnets. It only does the preparatory work.

"The current which is produced increases rapidly with the velocity. However small the machine be, the necessary magnetisation can always be attained, but one is obliged to expend a considerable amount of power, limited by the heating of the machine. I have succeeded, by theoretical considerations, and by a better distribution of the wire, in reducing the heat to a quarter and the expense to a third, producing, at the same time, the same effect.

	First machine.	Improved machine.
Expenditure of horse-power ...	1·394	0·51
Current strength	·98	·90
Velocity	1,447	1,433

"The expenditure of work, reduced to half a horse-power, is insignificant.

"Different types of Gramme machines have been constructed for electric lighting; the large and more costly ones will light 24 candles of ·004 mm. size; the smaller ones are capable of working 4 candles. I have noticed that these last machines are so feeble that they cannot be employed with advantage. When a low velocity is given them, they take little force to drive them; when this speed is increased to 2,500 turns, they absorb about 10 horse-power, and, as this work is transformed into heat in the circuits, it is evident that one ought to be able to light a number of lights, and obtain a larger amount of light in proportion, as the velocity is greater.

"However, this is not found to be the case, because the heat developed in the machine is such that the insulation of its wires becomes destroyed. It was very easy to remedy this defect by diminishing the resistance of the machine and increasing that of the circuit; this has been done with complete success, and allows of 24 lights being obtained with an 8 horse-power engine.

"I will simply give here the results of one of a number of experiments:—

VELOCITY: 1,530.

Number of lamps.	Intensity.		Horse-power expended.	
	Of each lamp.	Total.	Total.	Each Candle.
1	134	134	2·81	2·81
2	113	226	3·50	1·79
3	107	321	4·07	1·38
4	105	420	4·43	1·11
5	95	475	4·70	·94
6	96	576	4·91	·82
7	93	651	5·04	·72
8	92	736	5·11	·64
9	86	764	5·09	·57
10	74	740	5·07	·51
11	70	771	5·04	·46
12	62	740	5·01	·42
13	56	718	4·80	·37
14	50	700	4·60	·32

"It may be remarked that the expenditure of horse-power and amount of light obtained augments up to 9 lamps, after which these two quantities diminish. It is clear that, if we wish to have a greater total amount of light, we must not go beyond this maximum, but if we wish to have a greater number of lights, more feeble, we must exceed it; thus, when we have 14 candles of ·004 mm. size, a third of a horse-power each only will be required. But it would be better to stop a 2 candles of half a horse-power; they are finer and less unsteady. In proportion as the carbons are improved the limit may be overstepped.

"With regard to the light from each lamp, it diminishes with their number; a single lamp with a velocity of 1,500 turns will give a light equal to 134 Carcels, 2 reduces each to 113, and when the number becomes increased to 14, the light from each is diminished to 50; this is the division of a sum total, with a decreasing quotient.

"It may be remarked that this quantity of light is greater than with the ordinary candles; the cause is due to the carbons, which burn upwards instead of downwards. In one case the light is thrown upwards and is lost; in the other case it is thrown downwards, which is what is required. On the other hand, the flame of the arc, which tends always to rise, leaves the points and does not heat them when they are directed upwards; on the contrary, it envelopes them, and surrounds them with an atmosphere at an enormous temperature when they are turned downwards; this notably increases the amount of light given out. A photometric comparison of two identical candles in the same circuit has shown that the light from the turned down points is five times as great as that obtained with the points turned down. Although their temperature is enormous, the quantity of heat is not great, because the heat focus is small. I have compared this heat with that of a Carcel, by placing successively this lamp and an electric burner in the same calorimeter. The lights being equal, the combustion of the oil developed 45 times as much heat as did the electric arc.

"It remains for me to speak of the distance to which the light can be conveyed; it is greater in proportion as the velocity of the machine is greater; with 1,500 turns it is possible to introduce in the circuit 1 kilometre of copper wire ·001 millimetres in diameter without sensibly diminishing the light; with 2,000 turns 4 kilometres of this wire, or 16 kilometres of wire ·002 millimetres in diameter, can be introduced with a similar result. It is thus possible to conceive that a large town can be lighted from a single source.

"The experiments and numerous trials which I have been able to make with the motors and the machines have been a great tax upon my resources. I have, therefore, been very fortunate in having been assisted in every way by M. Durrieu, President of the Société du Crédit Industriel et Commercial. I am also equally indebted to the indefatigable exertions of M. Denayrouze, private tutor at the Ecole Polytechnique. I have also to thank MM. Maneuvrier and Krouchkoll for having so skilfully assisted me in taking the measurements."

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XII.

(Supplement to Article VIII.)

SOUNDERS.

BESIDES the forms of sounders shown on page 154 (Article VIII.), the instrument, fig. 53, is used to some extent for direct working. In this apparatus the sounder and galvanometer are combined on one base; the magnet is set horizontally instead of vertically, and an adjustment similar to that provided in the Morse Direct Writer Instrument (Article IV.) is provided, viz., the whole magnet can be shifted backwards or forwards by means of a screw, the electro-magnet sliding in a support. Such an adjustment is more necessary in direct working instruments than in those worked by a local battery, as the currents from the latter do not vary under ordinary conditions, to any appreciable extent, whereas the "line" current is continually changing. Beyond this adjustment there is nothing peculiar in the construction of the instrument which calls for remark, or which cannot be seen in the fig. The resistance of the electro-magnet of the instrument is 300 ohms, and the galvanometer 40 ohms, and good signals are given with about 5 milliwebers of current.

As has been previously pointed out, "Direct" Sounders are only worked to a limited extent in the Postal Service.

SINGLE CURRENT DUPLEX SYSTEM, WITH RELAY.

This system is employed on circuits of moderate length, which are beyond the range of the Direct Writer Duplex, but which, at the same time, are not sufficiently long to render the use of the Double Current system necessary.

The arrangement of the apparatus is very similar to that employed with the Double Current system; it is indicated by fig. 54. As compared with the latter system, it will be seen that the only difference that exists lies in the key, which is of the ordinary single current form.

The connections shown are those for an "Up" station; at a "Down" station the connections are similar, with the exception that the battery is reversed. The principle of the working of the system is exactly like that of the Direct Writer Duplex, that is to say, the relay is actuated in the same manner as is the electro-magnet in that system.

Rheostats.

The form of rheostat most generally employed by the Post Office is shown by fig. 55. The apparatus consists of a number of coils enclosed in a circular brass box with an ebonite top; two movable radial arms are provided, whose ends ride over and make contact with little platinum nipple contacts arranged in a circle around the circumference of the face of the ebonite top. Between these contacts the resistance coils of German silver wire are connected. The under ends of the radial arms are provided with spring platinum contacts which rub against the nipples referred to. A slight nick is filed in the contact of each spring into which the ends of the nipples fit, this keeps the arms steady in the positions to which they are moved.

The breadth of the ends of the spring contacts is such that contact is made with one nipple before it is broken with the preceding one, thus no interruption in the continuity of the circuit is caused when making an adjustment, nor can a disconnection be caused by the arms being set intermediate between two contacts instead of being moved so that the nipples fit into the nicks of the spring contacts, as should be the case.

The resistances in the apparatus are of the following values:—40, 80, 120, 160, 200, 240, 280, 320, 360, 400; these resistances are put in circuit by one of the radial arms; the second arm has resistances connected with it of the following values:—400, 800, 1,200, 1,600, 2,000, 2,400, 2,800, 3,200, 3,600, 4,000.

In front of the instrument 3 plug holes are provided, between which are inserted resistances of the values, 10, 20, and 4,000. The first two of these resistances, namely, 10 and 20, are used for making finer adjustments than are possible by means of the radial arms; the lower resistances connected to the latter, it will be noticed, progress in steps of 40 ohms each, but it is found that in bad weather a balance is very easily upset by a slight incorrectness in the resistance, and that a difference of 40 ohms was sufficient to cause this; by means of the two plug resistances referred to, the adjustment can be made within 10 ohms, which answers every purpose. The 4,000 ohms plug resistance is only used on very long circuits, where the balancing resistances required exceed 4,400 ohms.

The form of rheostat shown is better than a set of plug resistances, for when there are a number of plugs the latter are often knocked out accidentally or become loose in their holes.

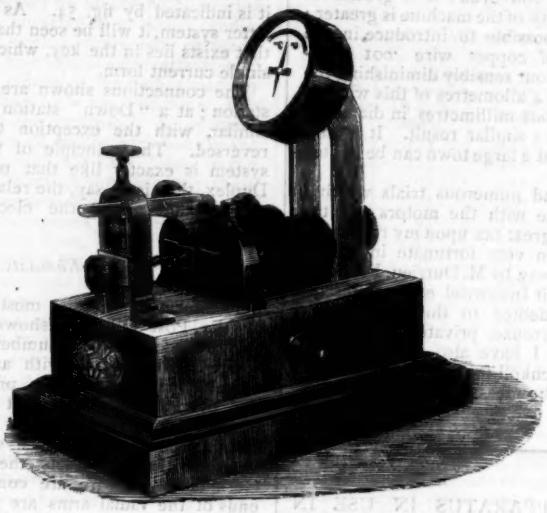


FIG. 53.

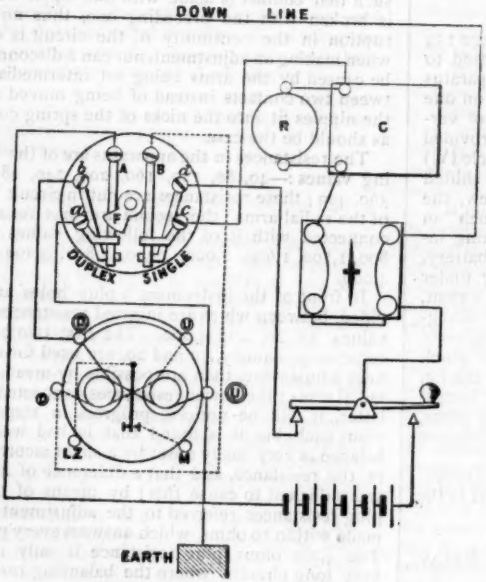


FIG. 54.

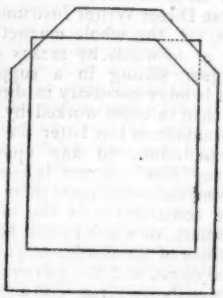


FIG. 57.

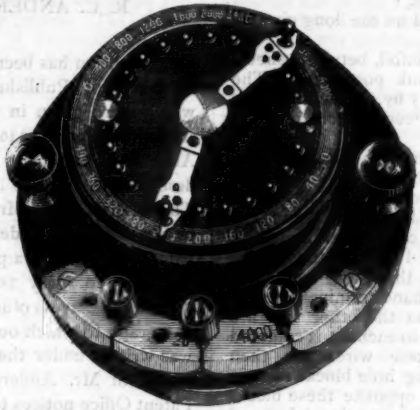


FIG. 55.

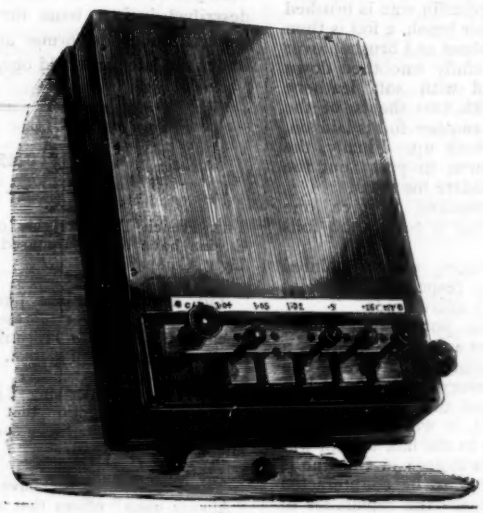


FIG. 56.

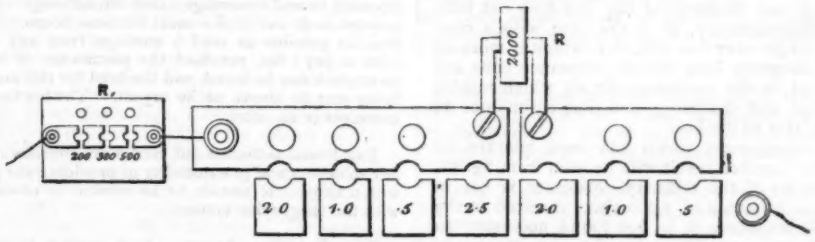


FIG. 58.

Condensers.

The form of condenser used on the long circuits is shown by fig. 56.

The plates are formed of tinfoil, between sheets of paraffined cream wove bank post paper. The paper is cut to the size of 8·55 by 7·3 inches. The tinfoil is of the thickness of ·00097 inch, and is of the size of 7·25 by 6 inches.

Two corners of the paper and one corner of each tinfoil are cut off, as shown by fig. 57. The foils and paraffined papers are laid together in layers, two papers being between each foil; the right and left-hand cut corners of the foils come alternately. A small copper lug is soldered to all the tinfoil corners on the one side, and this lug is connected by a piece of wire to the left-hand terminal, seen in fig. 56. The tinfoil corners on the other side are bunched together in sets, and to each set is soldered a copper lug and wire; these wires are then severally connected to the plug hole blocks seen in fig. 55. The long brass bar opposite these blocks is connected to the terminal seen to the right hand of the figure.

In setting up a condenser, the papers are first well dried, and then each in succession is placed on a heated plate and hot paraffin wax is brushed over by means of a camel-hair brush, a foil is then placed in the centre of the sheet and brushed over with paraffin, it is then carefully smoothed down with a piece of wood faced with soft leather; the foil is then covered with two sheets of the paraffined paper, and then another foil is laid on, and so on until the set is built up. Finally, the whole is subjected to pressure, to press out the surplus paraffin and to consolidate the mass.

The number of plates required to give one microfarad capacity is 57, that is to say, 28 foils between 29.

The whole number of plates, as was pointed out, is divided into sets, their respective capacities being 3·00, 1·00, 1·00, ·50, ·25 microfarads.

The amount of condenser power required to balance the static charge on a duplex circuit is a variable quantity, but in England about one or one and a half microfarads for every 100 ohms of line resistance seems to be about the average. Less capacity is required, as a rule, in wet weather than in fine, the cause being due to the fact that in wet weather only a portion of the charge in the line is discharged at the end and has to be counteracted by the action of the condenser; the remainder of the charge is lost through leakage.

On lines of a considerable length it is found that the charge and discharge of the line does not take place instantaneously, as is the case with a condenser; to get over this difficulty, which is more or less felt on every long circuit, resistance coils are introduced in the condenser circuit which retards the charge and discharge, and thus assimilates its action to that of the line.

The arrangement which has been adopted to effect the required result will be seen from fig. 58. The long bar of the ordinary condenser is cut in two and a resistance of 2,000 ohms inserted in the gap, this resistance it is not found necessary to alter. A resistance box with three resistances of the values 200, 300, and 500 ohms respectively is also included in the circuit, in the position shown, and through this the condenser discharge must take place.

R. C. ANDERSON'S BATTERY.

OUR attention has been called to a paragraph in our Abstracts of Published Specifications of Patents which were given in our last issue; it was there stated that Patent 4346. "Galvanic batteries. R. C. Anderson, October 24th," relates to batteries described in our last issue (June 1st), and is void. The description of Mr. Anderson's battery referred to was written as a description of certain batteries patented by him in a patent No. 3436, abstracted in our issue for May 1st, which patent we have no reason to believe is other than perfectly good, and the paragraph to which our attention has been drawn was written under the impression that the second patent of Mr. Anderson, which is stated in the Patent Office notices to be void, related to the same subject matter. In order to prevent any misapprehension we think it desirable to point out clearly that the batteries of Mr. Anderson, as described in our issue for June 1st, are manufactured under his former and good patent, and *not* under the later and void one.

Notes.

THE French Patent rights of the Otto Silent Gas Engine have been purchased by the Jamin Electric Light Company.

THE engineer for the Jamin Company is M. J. Berly, who no longer represents the interests of the Société Générale de l'Electricité, which, at present, works the Jablochkoff system.

IN our article describing Varley's Patent Time Ball we omitted to mention that the apparatus was constructed by Messrs. Siebe and Gorman, of the Westminster Bridge Road.

THE Postal authorities have issued instructions to the "Always open" offices that at every hour and a half attention must be directed to all the receiving instruments in the office, so that if a call is made it may be attended to and a message taken off, although the call may be made out of the usual business hours. It will thus be possible to send a message from any small town at any hour, provided the postmaster or instrument clerk can be found, and the need for the message being sent be shown to be urgent. The fee for such messages is 2s. extra.

THE Postal authorities of Berlin are considering the advisableness and practicability of providing the public with a telephonic service, to be worked in connection with the telegraphic system.

THE ELECTRIC LIGHT.—In a report to Sir E. Thornton, Mr. V. Drummond, of the Washington Legation, says:—"Mr. Edison's electric light cannot be said to have reached the successful point intended:

the trials are not, however, yet finished; when they are the results will be more clearly proved. The Brush electric light, however, seems to be successful for manufacturing purposes, as will be noticed from the following:—The electric light is coming into extensive use for a great variety of manufacturing purposes. The Telegraph Supply Company of Cleveland, O., report that they have sold over 1,000 Brush (electric) lights for use in rolling mills, machine shops, factories, and similar uses, displacing over 20,000 gas burners. One of the mills—the Riverside Worsted Mills of Providence—has used this light for nearly a year with excellent results. The managers, speaking of the success of the experiment, say 'that the lights could not have a severer test than we give them, as our mills run night and day the year through, and we have not had a moment's delay from, or a dollar's worth of repairs on, any of the machines or lamps. The light is all we expected; it is strong and steady, clear and white; it is universally liked by both overseers and help, so much so that we doubt if we could get along now with the help if we were to return to the old gas lighting, certainly we should not get so good work, nor so much of it. We use ground glass globes pretty generally throughout the mill, and we have less complaint of trouble to the eyes than we used to have with gas. The air of the room, too, shows a very marked difference. With the electric light the air is as good as in the daytime, and noticeably cooler. We had formerly about 250 gas burners of seventeen candle-power each, a total of 4,250 candle-power. We now have 20 electric lamps of 2,000 candle-power each, a total of 40,000 candle-power. Owing to some changes preparatory to setting up new machinery, all our 80 lamps are not at this moment in full service, but by actual count we have 71 lamps permanently placed, and these displace 578 gas burners; that is, there are 578 burners already placed that would be lighted were the electric lights stopped. Estimating these burners at 6 feet per hour, we should use 3,468 cubic feet of gas per hour, costing at 2 dollars per 1,000 cubic feet, 6 dols. 93c. per hour. The actual cost of the electric light is as follows:—The 71 lamps consume carbons, 80 cents.; power used for machines, 65c.; interest on cost of machines, say 15,000 dols. 30c.; men to run machines and lamps, 33c.; oil, wear and tear, &c., 3c. Total cost per hour, 2 dols. 50c.; making a saving of 4 dols. 73c. per hour, and this saving, for the 3,000 hours the machines run in the year, is 14,190 dols.'"

WE understand that the Brooks' underground system is to be tried by the Post Office authorities on a short distance from Waterloo to Vauxhall.

AN ELECTRICAL METEOR.—Mr. Pogson, British Vice-Consul at Hamburg, writes under date June 12th:—"A series of thunderstorms has lately passed over Hamburg. During the 11th inst. the air was densely charged with electricity; the storm broke about 10·15 p.m., lasting until 11 p.m., during which time, at very short intervals, from my station, about 1,200 yards distant from the copper-roofed tower of the church known as St. Jacobi, about 300ft. high, I saw this phenomenon apparently resting about 30ft. from the summit of the steeple. The colour was a reddish purple, and reminded one somewhat of burning potassium. From repeated comparisons with other objects during the lightning flashes, I judged these fire-balls (two were several times visible) to be from 4ft. to 6ft. in diameter. The longest duration that I timed was 42 seconds. This passing away of such dense masses of electricity by induction was visible some twenty times, but whether performed silently I had no means of ascertaining. From the apparent size of the flame and the non-lighting quality of the colour, I estimated it as equal to 10,000 candles. The colour was doubtless the effect of the glare of the copper roof."

THE Anglo-American Electric Light Company have taken the extensive premises known as the Victoria Works, Lambeth, for manufacturing purposes. A large engine and boilers by Messrs. Galloway are now being fitted up.

AT the commencement of 1879, Russia possessed 93,690 versts of telegraph line and 2,516 offices. 70,356 versts of the line is owned by the Government.

THE *Journal de Physique* for May contains a description of some investigations by Professor Colley of Kasan, on the phenomenon of luminosity of a negative electrode of small surface used in electrolysis, the liquid being acidulated water. The light which appears at the electrode was examined with a rotating mirror, and there were noticed a number of bright star-like points appearing only for an instant on a weakly luminous ground. The spectrum of the light was found to be composed of bright lines.

400 Jablochkoff candles were nightly burnt from June 1st to 10th, at the Palais de l'Industrie, Paris, the occasion being a floral exhibition. The effect was said to be magnificent.

ELECTRIC LIGHTS ON BUOYS.—The whistling buoys now in use weigh about fifteen tons each, and in their plunging, even during calm weather, a force of nearly three horse-power is evolved. To utilise this waste energy Mr. Edison has devised a small dynamo machine to be carried by the buoy, the current from which will sustain an electric light equal to one gas jet. If successful, these self illuminating buoys must be of great use to mariners.—*Scientific American*.

SOME experiments have been recently made on the Australian cables to show the distance to which messages can be transmitted; messages were exchanged between Melbourne and Port Darwin, a distance of 2,500 miles. The cable between Port Darwin and Singapore was then put into the circuit, and messages received in a few seconds, the signals being simultaneously repeated at Port Darwin.

MR. CYRUS W. FIELD, of Atlantic Cable celebrity, has prepared a map showing the telegraphic lines already constructed and in operation, and those which yet remain to be established to complete the telegraphic girdle about the world. The missing link is a section from some point on the Pacific coast to the Sandwich Islands, and thence to China and Japan. For this last, Mr. Field is understood to have secured important governmental concessions in connection with projected lines.

A NEW telephone has been devised by M. Marche of Paris. The instrument, which the inventor calls an "electrophone," is worked by means of an induction coil and is said to give very satisfactory results.

A NEW telephone has been recently described to the Paris Academy by M. Ader. The instrument consists of a disc of iron forming an armature and placed before the diaphragm of an ordinary Bell telephone. The centre of the disc is pierced with a hole similar in size to the opening in the mouth-piece of the instrument. This receiver worked with a microphonic transmitter gives

excellent results. M. Du Moncel explains the effect as due to the superexcitation which the armature produces in the magnet. The maximum effect appears to be obtained when the mass of the armature is equal to that of the magnet.

ELECTRIC light experiments on a large scale will be conducted with Wilde candles at the Universal Exhibition of Melun. The gardens will be opened every night and lighted by electricity.

SCOTTISH TELEPHONE EXCHANGE.—This company has now started its central telephone exchange in Edinburgh. The switching offices are 90a, George Street, and 68, Constitution Street, Leith. The rental to be paid varies from £10 to £20 a year, according to the facilities required. Call stations will be opened in different parts of Edinburgh and Leith for the use of subscribers. At present No. 34, St. Andrew Square, and 4, St. Gile's Street, can be used for the purpose.

IT has been resolved by the Philosophical Society of Glasgow to hold an exhibition of apparatus, illustrative of the most recent developments in the use of gas, electricity, &c., for lighting and other purposes. The scheme has been actively countenanced and encouraged by the gas and water committees of the Town Council, to whom the best thanks of the Society are therefore due. The range of subjects to be illustrated by the exhibition will include apparatus, appliances, models, or drawings that relate to, or illustrate, coal gas, oils, oil gases, candles; electricity and its generation and application to lighting purposes; architectural appliances relating to lighting, ventilation, heating, and lightning conduction; miscellaneous apparatus, such as gas-lighted buoys, fog horns, miners' safety lamps, firedamp indicators, &c. Awards for merit will be given for such classes of exhibits as the committee and exhibitors may arrange to be tested, or such other exhibits as may possess very special merit.

IMPROVED TELEPHONE CALL.—The *Boston Advertiser* describes an improved telephone call signal, which is about to be introduced in that city. It is not of application where a subscriber has a private wire, but is for use in the smaller cities where several subscribers are on the same wire, and, when one is called, all hear the bell, and each must have his separate call. It is a device by which only the person desired may be called and so, without any particular style of call, as at present, he knows whenever he hears the bell that it is for him. The apparatus is something like this:—At the central office is a clock which regulates a clock in the office of each subscriber on the circuit, so that they all run in exactly the same time. This is done by setting the subscribers' clocks, so that whatever variation they have will make them faster than the central clock, and by a current of electricity they are made correct once in every minute. Upon the faces of these clocks and the central one is a dial around the second hand, marked off into as many divisions as there are subscribers on the wire. Whenever the second hand is in the division marked "1," the subscriber who has that number may be called and no other one will hear the bell. The same is true of No. 2 and so on around the circle. Suppose there are eight subscribers on the wire, each would have seven and a half seconds every minute in which he could be called—deducting a brief interval of silence at the beginning, which is given in order that the calls may not be mixed. As two seconds is ample time for calling a person, it will be seen that there is a good margin allowed. The apparatus is simple. A wire extends from each clock to the central clock, and at each clock is an electric call bell. A single cell in the battery is used, which gives enough electricity to call one bell, but not two. The possibility of the invention turns upon the fact that electricity will take the shortest path possible. When the bells are silent the electric current is passing along a direct line of wire, but when the bells sound the current is passing through several hundred feet of wire coiled at the bell, which closes the circuit when the fingers press the key in the central office. This change in the circuit is made by a simple arrangement in the clock, by which a lever is thrown in one position or another, turning the current into the coil or sending it straight on. If there were enough electricity on, the bells would all ring, but only enough is generated to ring one bell, and that bell is the one which, for the time being, is affected by the electricity in its coil. Since only one coil is affected at one time, only one bell will ring, and when a subscriber hears it he is sure it is for him. Mr. George H. Bliss is the patentee, and the patent is owned by the Signal Telephone Corporation.

THE Silvertown Company are largely manufacturing the improved Leclanché agglomerate cells, in which the porous pot is entirely dispensed with. This form of battery, which was described in the *Telegraphic Journal*, Jan. 1st, 1879, consists of the ordinary Leclanché zinc immersed in sal-ammoniac solution. The negative element is a carbon plate with two agglomerate plates secured to the former by india-rubber bands.

The advantages of the new cell with agglomerate plates are thus enumerated:—

1. A much better use is made of the depolarising power of the manganese, as the reduction of it is more complete than in the porous pot form, where the manganese while being reduced clogs, and prevents the action of the battery long before the whole of the manganese is reduced.

2. In consequence of the readier reduction of the manganese, the carbon plate is more rapidly depolarised than with the porous pot form, and consequently the electromotive force is more sustained.

3. The resistance is *extremely constant*, whatever the electro-chemical work done by the cell may be, and will even tend to decrease in consequence of the formation of chloride of zinc, which is an excellent conductor.

4. The battery is ready for use immediately on charging, because the liquid is brought into direct contact with negative and positive elements.

5. The renewal is exceedingly simple. When the battery becomes exhausted, the depolarising plates, which are joined to the carbon plate, have only to be removed and fresh ones substituted.

6. By avoiding the use of porous pots, the risk of breakage and deterioration is very much lessened, and the cost of renewal considerably reduced.

7. The trouble and cost of maintenance are next to nothing.

THE SAFETY OF RAILWAY PASSENGERS.—The last report of the Madras Railway Company contains an interesting statement respecting the working of Mr. G. K. Winter's patent electrical communication in all the company's trains, and the invention of an apparatus by the same gentleman, which provides a visible danger signal to the driver until the line is blocked. The report states:—"The new electrical communication (Winter's patent) in all trains which carry passengers, and which was introduced at the beginning of the first half-year of 1879, was still further extended during the second half-year, and out of a total train

mileage of mail and day passenger trains of 326,084, this communication was adapted to a mileage of 324,224. The percentage of interruptions, which in the first half-year was 1·43 per cent., was reduced during the second half to 0·57 per cent., a result which may be looked on as most satisfactory. The Madras Railway Company may congratulate itself on having introduced into India, for the safety of passengers, a system almost practically perfect (the invention of one of its own officers), at an initial cost very little in excess of the obsolete and inefficient bell and cord communication, while the cost of its up-keep is actually considerably less." And the Chief Engineer remarks:—"Another question taken up by Mr. Winter, at the instance of the Traffic Manager, was an arrangement by which drivers should have a visible danger signal against them until the line was blocked. This he has successfully accomplished by an apparatus which he has invented for electrically interlocking the block instrument with small semaphore signals on either side of the station. Estimates of the cost have been received, and the question of adopting the invention will be duly considered."—*Ironmonger*.

PRIZES FOR NEW APPLICATIONS OF ELECTRICITY.—*The Journal Officiel de la République Francaise* says:—"A decree dated 7th February, 1852, instituted a prize of 50,000 francs for the best application of the Volta Pile. The first award of this prize was made to M. Ruhmkorff in 1864, for his improved apparatus, which were of great service to industry in general.

"Two later decrees, one dated April 18, 1866, and the other dated 29th November, 1871, threw this prize open to new applications of electricity. A ministerial order dated 26th December, 1876, formed a commission to inquire into this very important branch of physics. As a result of that inquiry the Government propose to award: 1st. 50,000 francs to Mr. Graham Bell, Professor of Vocal Physiology at the Boston University, for the invention of an articulating electro-magnetic telephone. 2nd. 20,000 francs to M. Gramme, instrument-maker, for a magneto-electric machine which produces electricity by motive power. Although the Government propositions exceed those of the special commission which was appointed to inquire into the matter, and whose proposal was to award the only prize to Mr. Graham Bell, while drawing attention to the great merits of three other *savants*, yet the Budget Committee thinks that special notice should also be taken of the great benefits conferred on the public by M. Gramme's inventions, and they therefore strongly recommend that the amounts proposed by the Government should be voted. This second award is so exceptional that the action of the Budget Committee on this occasion 'should not be considered a precedent.'"

ACCORDING to the *Golos*, the Governors of Eastern and Western Siberia have solicited permission for the immediate erection of telegraph lines as far as and along the Chinese frontier. The line solicited by the Governor of Western Siberia is 600 kilometres in length, and he asks for its erection a grant of 100,000 roubles. The length of the line proposed by his colleague of Eastern Siberia is 100 kilometres in length. The object of the latter line is to render communication easier between the troops, and more especially to bring forces readily against the Chinese robbers, the Chunguses. The former line seems entirely intended to do service in the event of Russo-Chinese hostilities.

THE INSTITUTION OF CIVIL ENGINEERS.—A new list of members has just been issued, from which it appears that there are now on the books 1,217 Members, 1,299 Associate Members, 579 Associates, 18 Honorary Members, and 657 Students, together 3,770 of all classes. At the same period last year the numbers of the several classes were 1,148, 1,200, 622, 17, and 591 respectively, making a total of 3,578; showing an increase at the rate of nearly 5½ per cent. During the past session the elections have comprised 2 Honorary Members, 43 Members, 129 Associate Members, and 15 Associates; and 160 Students have been admitted.

THE Antwerp International Bell Telephone Exchange Company now numbers about 200 subscribers.

WE regret to have to announce the death of M. Gaugain, the eminent electrician.

A VERY successful application of the electric light has been exemplified in the lighting of the Orient S.S. *Chimborazo*, which left Gravesend on the 24th for Australia. The installation consists of a Gramme machine generating the current by which seven incandescent lamps using 2 mm. carbons are worked. Four of these are fixed in the main saloon, and the remainder in the steerage, where this mode of lighting is a great desideratum. The lamps are placed in series, but a resistance coil and automatic switch renders each independent from its neighbour. Several spare lamps are carried which can be worked from the same machine. The whole current can also be switched on to a Crompton arc lamp, which is contained in a special lantern fitted with a reflector. This will be used when in port for loading and discharging cargo. The actual illuminating power of the large lamp is 4,000 candles, while each of the small incandescent lights is about 70. The whole of the arrangements have been carried out under the superintendence of Mr. Killingworth Hedges, C.E., the incandescent lamps and Gramme machine being supplied by the British Electric Light Company. The extension of the lighting to the other parts of the ship will be completed on her return.

MR. L. G. TILLOTSON, of the firm of L. G. Tillotson & Co., has just rendered a service which merits the thanks of the telegraphic interest everywhere. Mr. Tillotson, supported by President Eckert and Vice-President Bates, of the American Union Telegraph Company, has brought to light certain evidence which supplies the missing link in the chain of testimony required to prove the worthlessness of the Simpson (or Colgate) claim to a patent for the use of gutta-percha as an insulating substance for wires used for submarine or subaqueous purposes, and in settlement of which large sums have been paid by various companies. The American Union Telegraph Company and Messrs. L. G. Tillotson & Co. have steadily refused all offers for a compromise, believing, as most intelligent telegraphers do, that the patent is invalid. Tillotson & Co. now invite all parties who have paid moneys upon such claim, or against whom such claims are pending, to an examination of the proof in their possession, which has so long slumbered among the Patent Office files, and which, upon the recent trial, was either suppressed or ignored, or at all events was studiously and successfully concealed, as a basis of resistance to said claims.—*The Operator*.

THE Albert Medal of the Society of Arts for 1879 has been presented to Sir William Thomson for his electrical researches, especially those relating to the transmission of telegraphic messages through submarine cables.

MR. T. G. ELLSWORTH, manager of the Telephone Exchange at 198, Broadway, of the Metropolitan Telephone and Telegraph Company, has recently invented a new style of switch board for facilitating and simplifying the operation of the lines connected with the Exchange. The invention consists of a board provided with a number of longitudinal bars, used to connect the wires of the different subscribers. When these bars are in use they are turned to indicate that they are occupied, so that the operator may know at a glance which rods are occupied, like an annunciator in an hotel. This switch board stands four feet away from the telephones, the number of which used is by this invention largely reduced, as also are the batteries required. It also enables the Exchange to dispense with the services of a switchman.

FIFTEEN thousand dollars have been voted by Congress for a statue of Prof. Henry, to be placed in the Smithsonian grounds.

Reviews.

Catalogue of Books and Papers relating to Electricity, Magnetism, the Electric Telegraph, &c., including the RONALDS LIBRARY. Compiled by SIR FRANCIS RONALDS, F.R.S., with a Biographical Memoir. Edited by Alfred J. Frost. London: E. & F. N. Spon, Charing Cross.

THIS Catalogue has been recently published by the Society of Telegraph Engineers in compliance with the terms of the agreement under which the Society was to possess the valuable library of Sir Francis Ronalds. The magnitude of the work may be judged from the fact that the volume contains over 560 pages. To execute such a task in the satisfactory manner it has been done was by no means an easy matter, and an examination of the Catalogue will satisfy the most critical person that no better man could have been selected for editing the work than Mr. A. J. Frost, the acting librarian of the Society of Telegraph Engineers.

The richness of electrical literature is amply testified by the fact that over 13,000 of books, pamphlets, and other publications on the subject are referred to.

The headings are chiefly the names of the authors of the works, and in cases where any particular interesting facts are contained in any work the substance of the same is referred to.

The volume appropriately commences with a memoir of Sir Francis Ronalds by the Editor.

It is only necessary to add that the general "get up" and printing of the volume are excellent.

Electric Light, its Production and Use, embodying plain directions for the working of Galvanic Batteries, Electric Lamps, and Dynamo-Electric Machines. BY J. W. URQUHART, C.E. Edited by F. C. Webb, M.I.C.E. London: Crosby Lockwood & Co.

THIS volume contains a general account of the means adopted in producing electric light whether by batteries or dynamo-machines. The work contains nearly 300 well-printed pages, and numerous illustrations.

Although theory is wisely steered clear of to a great extent, in many cases where it is introduced the correctness of the statements is decidedly open to question. The practical matter which forms the mass of the volume is, however, generally well chosen and very useful. Voltaic batteries, thermo-electric batteries, magneto-electric generators, electro-magneto electric machines, dynamo-electric machines, electric candles and lamps, measurement of electric light, cost of electric light, are all treated of, and the most recent information on the subjects is worked into the chapters. Altogether the work is a useful one and worth being published.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

(*Continued from page* 218.)

To melt a gram of steel in the electric furnace takes, therefore, 450 × 15 = 6,750 units, which is within a fraction the heat energy residing within a gram of ordinary coal. It results from this calculation that, by means of the dynamo-electric machine worked by a steam engine, one pound of coal is capable of melting one pound of mild steel. In melting steel in the ordinary air furnace, as practised at Sheffield, three tons of best Durham coke are consumed to melt a ton of mild steel in crucibles, and in working with the Regenerative Gas Furnace, one ton of coal effects the fusion of one ton of steel in crucibles, whilst to produce steel in large masses on the open hearth of this furnace, 12 cwt. of coal suffice to produce one ton of steel. The electric furnace may be therefore considered as being more economical than the ordinary air furnace, and would, barring some incidental losses not included in the calculation, be as regards economy of fuel nearly equal to the Regenerative Gas Furnace.

It has, however, the following advantages in its favour:—1st. That the degree of temperature attainable is theoretically unlimited. 2nd. That fusion is effected in a perfectly neutral atmosphere. 3rd. That the operation can be carried on in a laboratory without much preparation, and under the eye of the operator. 4th. That the limit of heat practically attainable with the use of ordinary refractory materials is very high, because the fusing material is at a higher temperature in the electric furnace than the crucible, whereas in ordinary fusion the temperature of the crucible exceeds that of the material fused within it.

Dr. Siemens next described the results of his experiments on electro-horticulture, the account of which was similar to that given in the *Telegraphic Journal* for April 1st.

For electro-horticulture generally, it is important to employ a lamp with its focus unchangeable in space, and without obstruction to the rays of light falling downward. The novelty of the lamp designed for this purpose consists in the mode of advancing the carbons, which, instead of being effected by clockwork (as has been the case hitherto in constructing regulators), is

effected simply by the force of gravity, or by spring power urging the carbon forward towards the point of meeting, in which forward motion each carbon is checked by a metallic abutment, in the form of a point or edge of copper or other metal of high conductivity, the exact position of which can be regulated by a screw.

This metallic ridge touches the carbons laterally, at a distance of 10 to 15 millimetres from the luminous point, where the temperature of the carbon is sufficient to cause its gradual decomposition in contact with the atmosphere, without being high enough to fuse or injure the metal.

In its application to horticulture, a metallic parabolic reflector of considerable diameter is placed over the luminous centre, in order to reflect downwards all the rays of light and heat which would otherwise pass upward, an arrangement which may be advantageously carried out in these lamps as used for illumination when placed at a considerable elevation above the ground.

Dr. Siemens next alluded to the application of the dynamo-electric current to mechanical propulsion, and explained the electric railway, which was described in the *Telegraphic Journal*, February 15th.

It is a remarkable circumstance in favour of the electric transmission of power, that while the motion of the electro-magnetic or power receiving machine is small, its potential of force is at its maximum, and it is owing to this favourable circumstance that the electric train starts with a remarkable degree of energy. With the increase of motion the accelerating power diminishes until it comes to zero, when the velocity of the magneto or driven machine becomes equal to that of the dynamo or current-producing machine. Between the two limits of rest and maximum velocity the driving power regulates itself according to the velocity of the train; thus, on an ascending gradient the speed of the train diminishes, but the same effect is automatically produced which results from the turning on of more steam in the case of the locomotive engine. When running on the level, the velocity of the train should be such that the magneto-electric machine should make one-half to two-thirds the number of revolutions per minute as the dynamo-electric. When descending, the speed of the magneto-electric machine will be increased, in consequence of the increased velocity of the train, until it exceeds that of the dynamo-electric machine, from which moment the functions of the two machines will be reversed; the machine on the train will become a current generator, and pay back, as it were, its spare power into store, performing at the same time the useful action of a brake in checking further increase in the velocity of the train. If two trains should be placed upon the same pair of rails, the one moving upon an ascending portion, the other upon a descending portion of the same, power will be transmitted through the rails from the latter to the former, which may therefore be considered as connected by means of an invisible rope.

In transmitting the power of a stationary engine to a running train, the proportion of power actually transmitted varies with the resistance to or speed of the train, reaching practically a maximum when the velocity of the machine on the train is about equal to two-thirds that of the current-generating machine, at which time more than 50 per cent. of the power of the stationary engine is actually utilised.

In passing through an adit or tunnel, the entire freedom of smoke from the electro-motor is a matter of great importance; and the administration of the St. Gothard Tunnel contemplate seriously the application of an electro-motor for conveying trains through that gigantic tunnel. Circumstances are in this case highly favourable to the employment of an electro-motor, because at both ends of the tunnel turbines of enormous aggregate power are actually established (having been employed in the operation of boring the tunnel), and all that has to be done is to insulate one of the rails, and to connect dynamo machines of sufficient power to the turbines and to the train itself.

Instead of insulating one of the rails, a copper or other conducting rope may be used to convey the current from the dynamo machine to the train. This conducting rope would rest upon wooden or glass supports, to be picked up by the train in order to pass over one or more contact pulleys, and to be again deposited behind the train. This plan offers the advantage that no insulation of the rails or any of the driving wheels of the train is necessary, both rails fulfilling the office of return circuit. The cost of a copper rope, which in the case of a full-sized railway of great length would be a considerable item of expenditure, would not be heavy in this case. Practice alone can determine which of the two modes of construction is the best, but both can be made efficacious, and the preference will be due to economical or structural considerations.

PHYSICAL SOCIETY.—JUNE 12th.

Dr. HUGGINS, F.R.S., in the Chair.

New Members—Mr. H. B. JUFF, Mr. ADAM HILGER, Mr. C. V. BOYS.

Dr. SHETTLE, of Reading, read a paper on the influence of solar radiation on the earth's rotation. The fact established by Dr. Shettle, that the magnetic energy of a bar magnet acts along spiral lines, has led him to surmise that the energy emanating from the sun and impinging on the earth on the zone of the ecliptic, traverses the earth in a spiral path, and finally emerges at the magnetic poles. The spiral of energy is "right-handed" at one pole, and "left-handed" at the other, like the magnetic force in a magnet, and the electric discharge in Crooke's vacuum tubes. Owing to precession and nutation these spiral paths are constantly changing and producing magnetic variations. He therefore infers that the magnetic poles will complete a cycle corresponding to the period of precession. Dr. Shettle thinks that bodies exhibit magnetic properties in proportion as they change the direction of the energy traversing them, and throw it into the spiral form. Terrestrial magnetism would be due to the solar radiance on this hypothesis. Gravity also would be produced; so, likewise, would the earth's rotation (by a kind of "magnetic whirl"), electricity, tornadoes, cyclones, water-spouts, and whirlwinds. Moreover, this "spiral energy" would seem to operate throughout the whole universe.

Prof. WIEDEMANN, of Liepsic, made a communication on the phenomenon of interference in rays of long path, and showed how the phase of vibration of the atom or molecule emitting the rays influenced the phenomenon. Molecular collisions could operate in preventing interference. From a study of this question he was able to deduce a method of determining the pressure on the surface of the sun and stars. He mentioned that he had found that the temperature of a glowing gas in Geissler's tubes may be under 100° Cent., and therefore the light of the Aurora, or of comets, might be accompanied by a low temperature. He had determined that the quantity of heat produced in a gas by the electric discharge was always the same with the same amount of electricity, whether discharged at once or not, and that it increases nearly in proportion to the pressure of the gas. He had also determined that the heat which must be developed by a discharge in hydrogen in order to change the band

spectrum of H into the line spectrum is about 100,000 calories for 1 gramme of hydrogen, and hence this might represent the amount of heat necessary to transform the hydrogen molecule into its atoms, Dr. SCHUSTER suggested that Prof. Wiedemann should make a similar experiment with another gas, say nitrogen, as there was a disagreement about the H spectra, and Prof. WIEDEMANN stated that he so intended.

Mr. RIDOUT exhibited a device for amplifying small motions. A small barrel is slung by two threads between the prongs of a metal fork in such a manner that if the fork is bodily carried to and fro the barrel will rotate round its axis. This is simply effected by making each thread, in its passage from one prong to the other, take a few turns round the barrel. To the barrel an index is attached and the fork is then fixed on the body whose minute motion is to be indicated. The translation of the body shifts the fork and rotates the barrel, which in turn deflects the index round the face of a dial, and the magnifying power is expressed by the ratio of the diameter of the barrel to the length of the index. With this apparatus Mr. Ridout exhibited the lengthening of an iron core when magnetised by the passage of the current of 2 Grove's cells through an insulated wire coiled round it. By rivetting a slip of brass to the iron the unequal expansion of brass and iron under heat was also shown, the heat being generated by keeping the current flowing in the coil.

Mr. D. WINSTANLEY exhibited his new radiograph for recording graphically the intensity of solar radiation throughout the day. It consists of a differential thermometer, with one black bulb and a circular stem. The lower part of the stem is filled with mercury, the upper branches with sulphuric acid and water. The tube is mounted on a brass wheel, so that when the black bulb is exposed to the sun's rays the differential motion of the mercury causes the wheel to turn. The wheel carries a light index or marker, which is free to traverse a vertical cylinder covered with paper coated with lampblack, and leaves a white track where its point has scratched off the soot. The radiogram thus produced can be fixed and preserved. Dr. GUTHRIE pointed out the curious "thermal twilight" these radiograms had betrayed to Mr. Winstanley. They show that before sunrise the temperature increases, owing to solar radiation. Moreover, half-an-hour after sunset the index falls and remains till within a few moments of midnight, when it mysteriously rises and sinks again, although the sun is then directly over the opposite hemisphere.

Mr. BAILLIE then gave the results of a study he had made into the theory of the phoneidoscope. He finds that waves simultaneously start from each side of the soap film when the note is sounded, and, meeting in the middle, generate ventral points and notes. The equations of several cases were given by him, and he suggested that photography should be employed to fix the appearance of the figures in order that they might be investigated theoretically.

The following are the final quotations of telegraphs for the 28th ult.—Anglo-American Limited, 61½-62; Do., Preferred, 91½-92½; Ditto, Deferred, 33¼-34; Black Sea, Limited, —; Brazilian Submarine, Limited, 8½-8¾; Cuba, Limited, 9¼-9½; Cuba, Limited, 10 per cent. Preference, 15¾-16¼; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10¾-11¼; Direct United States Cable, Limited, 1877, 11¼-11½; Scrip of Debentures, 102-104; Do., £50 paid, 1-3; Eastern, Limited, 8¾-9¼; Eastern 6 per cent. Preference, 12¼-12¾; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-105; Eastern 5 per cent. Debentures, repayable August, 1887, 103-105; Eastern, 5 per cent., repayable Aug., 1899, 104-106; Eastern Extension, Australasian and China, Limited, 9-9¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-107; Eastern and South African, Limited, 5 per cent., Mortgage Debentures redeemable 1900, 101-104, Ditto, ditto, to bearer, 101-104; German Union Telegraph and Trust, 8¾-9¼; Globe Telegraph and Trust, Limited, 5¾-6¼; Globe, 6 per cent. Preference, 12-12¼; Great Northern, 9¾-10; Indo-European, Limited, 22¾-23½; London Platino-Brazilian, Limited, 3¼-4; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¼-11; Reuter's Limited, 9¼-10½; Submarine, 235-245; Submarine Scrip, 2¼-2½; West Coast of America, Limited, 1¾-1¾; West India and Panama, Limited, 1¼-1½; Ditto, 6 per cent. First Preference, 7-7¼; Ditto, ditto, Second Preference, 6¼-7; Western and Brazilian, Limited, 6¾-7; Ditto, 6 per cent. Debentures "A," 100-103; Ditto, ditto, ditto, "B," 100-103; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 33½-34; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3¼-3¾; India Rubber Company, 15-15½; Ditto 6 per cent. Debenture, 105-107.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital of exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
May, 1880 ...	*	10,326	2,900	1,334	*	42,963	26,570	19,480	... ...	*	... ...	8,999	3,715
May, 1879 ...	47,910	12,810	3,108	984	15,970	38,371	25,845	18,917	... ...	11,458	... ..	12,430	5,559
Increase	... ...	... ...	... ...	350	... ...	4,592	725	563	... ...	... ...	... ...	... ...	... ...
Decrease	... ..	2,484	248	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	3,431	1,834

* Publication of receipts temporarily suspended.